

# THE FIRE ANT

An imported species of this insect has become a serious pest in the South. It is studied both to find means to control it and to learn how a species adapts itself to a new environment

by Edward O. Wilson

"Fire ant" is the common name of many ant species distributed throughout the tropical and warm temperate regions of the New World. The sting of these ants causes a burning sensation, hence the name. Three species of fire ant are native to the

southern U. S.; a fourth (*Solenopsis saecivissima*) was introduced from South America around 1918. For 10 years the imported fire ant lived within the city limits of Mobile, Ala.; then it began to spread. It has now become a dominant species over a large part of the South,

and has developed into a serious pest.

It is not only a serious pest but a versatile one. In South America the normal diet of the fire ant appears to consist mostly of seeds, the flesh of insects and "honeydew" gathered from living insects such as aphids. But its dense



FIRE ANTS swarm out of a fire-ant mound which has been broken open. These ants are workers, which sting fiercely. The mound is

honeycombed with passages. It is built by the workers out of tightly packed particles of soil; thus it has considerable strength.

populations in the U. S. have extended this diet to include, to the grief of farmers, the seedlings of several important food crops and the newborn young of poultry and livestock. Nesting fire ants build large mounds, numbering up to 50 an acre, which hamper plowing and harvesting. Moreover, worker ants swarm aggressively out of the nests at the slightest disturbance, making manual labor in infested fields painful and difficult. Some farmers who have heavily infested land are unable to hire sufficient help, and are forced to abandon land to the ants. In two counties of southern Alabama the crop damage caused by fire ants was recently estimated at more than \$50,000. The total agricultural loss in the South probably extends into millions of dollars.

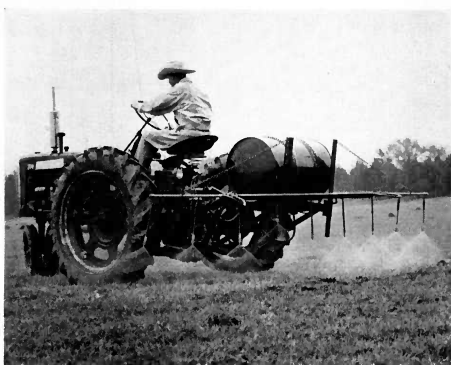
The onslaught of the fire ant has reached such proportions that the Federal Government has undertaken to conduct a special control program. Last spring Congress appropriated \$2.4 million to the Department of Agriculture for this purpose. The Department's plan, which is being put into effect now and is scheduled to last for several years, calls for the spraying of 20 to 30 million acres with Dieldrin, a hydrocarbon insecticide many times more toxic than DDT. The Dieldrin will be distributed both from the ground and from airplanes.

**T**his unhappy tale has a special interest for the student of organic evolution. A fundamental problem of evolution is: How does a species adapt itself to a new environment? The problem is dramatized by the special case of animals and plants transported by man to areas far from their native ranges. Some transplanted species are immediately successful, building up huge populations until they become dominant members of the local fauna and flora; related species completely fail to establish themselves. Still other species follow a more baffling pattern. For a time they maintain a limited and precarious "beachhead"; then suddenly and unpredictably they explode into a phase of rapid expansion. The imported fire ant occupies the last category.

Like most other ants, fire ants are dispersed by the nuptial flights of males and winged virgin queens. During the flight a queen may travel as far as five miles from the colony of her origin. After she mates with the male she descends to earth, excavates a simple burrow in the soil, and over a period of several days lays approximately 100 eggs. The



**FIRE-ANT MOUNDS** dot a field in Mississippi's Lowndes County. The mounds interfere with plowing and harvesting. The ants also infest the seedlings of several important crops.



**INFESTED FIELD** in Lowndes County is sprayed with insecticide in a water emulsion. One treatment is capable of eliminating the ant from a field for as long as three years.

first brood of worker ants then develops very rapidly. The eggs hatch in about nine days, the larvae change to pupae after about the same period, and adults emerge from the pupae about a week later. Often small groups of queens cooperate to found colonies. Later, however, the first emerging workers execute the surplus queens so that only one remains. Once established, the young colony grows with startling speed. Within four or five months it contains over 1,000 workers. In a year it swarms with tens of thousands of workers and has reached sexual maturity; that is, it has begun to produce the winged males and queens which start the life cycles of new colonies.

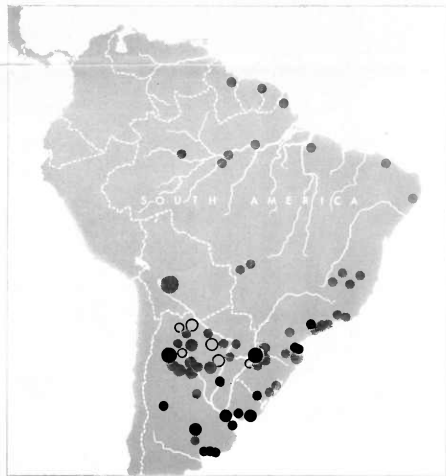
Given this means of dispersion, exactly how did the imported fire ant spread in the U. S.? As I have indicated, the imported population was at first quiescent and then exploded. We now know that at the beginning of the explosive phase an important change in the genetic structure of the population occurred. In the 1920s, following the in-

roduction of the colony into Mobile, it consisted entirely of a relatively large, blackish-brown form that corresponded exactly to the southernmost race of the mother population in South America. The range of this race is northern and central Argentina and part of southern Uruguay. The founding colony (or colonies) may have come from Buenos Aires or Montevideo in ships. Once established in Mobile, the dark form was not notably successful. William S. Creighton, a Harvard University graduate student in entomology who studied the population in 1928, found it limited to Mobile and the suburban community of Spring Hill. There was no inkling of the explosion to come.

Sometime in the 1930s a second form of the imported fire ant made its appearance in the Mobile area. It was reddish-brown in color, smaller in size than the original immigrant, and it built smaller nests. Its origin is not positively known. Three possibilities have been considered: (1) that the second form was introduced from another part of South

America, (2) that it was a mutation of the original dark form, (3) that it represented a recombination of genes already present in the dark form. Several lines of evidence point to the first alternative. Where light and dark colonies meet we find colonies of many intermediate colors. This suggests that the variation in color is controlled not by one gene but by several. Moreover, the light and dark forms differ in characteristics other than color, and these characteristics vary independently of one another; thus they are probably controlled by different groups of genes. So it seems unlikely that mutation or recombination can account for the sudden appearance of the complex genetic structure of the light form.

Furthermore, recent studies have shown that the light form, or its close equivalent, occurs abundantly in certain parts of northern Argentina and southern Bolivia. Perhaps like the dark form it was introduced into the U. S. in cargo shipped out of Buenos Aires or Montevideo. Whatever the origin of the light form, the significant fact is that it



FIRE-ANT SPECIES imported from South America is widely distributed there. Black dots represent the dark form of the species; circles, the light form; gray dots, all other forms.



SPREAD OF SPECIES began about 1918. Black lines show the limits of the central

appeared at just about the time that the population as a whole began its rapid growth in all directions out of Mobile.

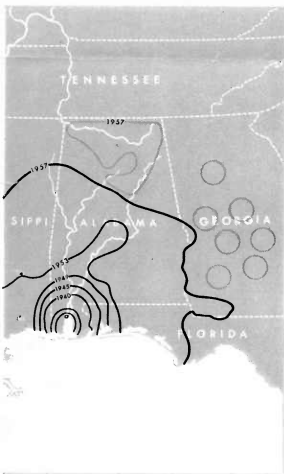
When I first began to study the imported fire ant in 1949, I noticed that the two color forms were distributed around Mobile in a curious and significant pattern. The dark form was very rare within the city itself, despite the fact that it had been the predominant or exclusive form when Creighton studied it there 20 years earlier. Now it was limited to a few isolated localities concentrated mostly along the southern periphery of the range (see map at right below). Everywhere else in the Mobile area the teeming colonies were composed of the light form. To the north, in the Mississippi towns of Meridian and Artesia, there were small secondary populations consisting entirely of the dark form. Investigation showed that these localities had been colonized by ants from the Mobile area during the 1930s, probably while the dark form still predominated in the primary popu-

lation. Other isolated populations were found at Thomasville and Selma in Alabama. These consisted entirely of the light form. As one might have predicted, it was subsequently disclosed that these light-form populations were quite recent in origin, being no more than five years old in 1949. Compared to the dark-form populations of Mississippi, they were remarkably successful and fast-growing. The Selma population, in fact, already exceeded in size both Mississippi populations taken together.

All this information clearly indicated that the imported fire ant was in the midst of a rapid evolutionary change. The conclusion seemed inescapable that the light form, which had originated in the Mobile area sometime after the introduction of the dark form, was adaptively superior to the dark form and was replacing it over most of its range. Additional field studies conducted by William L. Brown and myself in 1956 and 1957 have corroborated this interpretation. We found that in the interval between 1949 and 1957 the dark form had con-

tinued to decline in the center of the main population, while the growing edge of the population had come to consist almost entirely of the light form. In some areas where the dark form had been abundant in 1949 it was now absent; only the light form persisted. By 1957 the dark-form population at Meridian had been engulfed by the northward-expanding main population, and the light form was quickly rising to predominance there. The Artesia population, 70 miles to the north of Meridian and still isolated, remained uniformly dark in composition, but its rate of spread had been far less than that of nearby light-form populations.

These most recent studies indicate that replacement of the dark-form genes is proceeding not only by genetic "swamping" but also by direct conflict between colonies. The dark form appears to be losing out in the struggle because its nest-founding queens and young colonies are destroyed by the fiercely aggressive mature colonies of the light form. Young dark-form colonies are



population by years. The gray lines indicate the limits of secondary populations in 1957.

DARK FORM OF SPECIES comprises more than 20 per cent of population in dark areas; 20 to 5 per cent in heavily hatched areas; less than 5 in light hatched. Dots are small colonies.



WORKER ANTS remove larvae from exposed part of nest. When the nest is disturbed, workers rush out to sting the interlopers. The

sting is not so painful as that of a honeybee or a wasp, but it is extremely effective when delivered by large numbers of ants.



YOUNG QUEEN ANT shown in this photograph is winged, as is the male. When the male and the queen make their nuptial flight,

they may travel as far as five miles. Four or five months after they have mated, the new colony contains more than 1,000 workers.

very rare today in areas where mature colonies of the light form exist in any number. To look at it another way, the dark form appears to be declining because, under competitive pressure from the light form, it is unable to reproduce itself adequately.

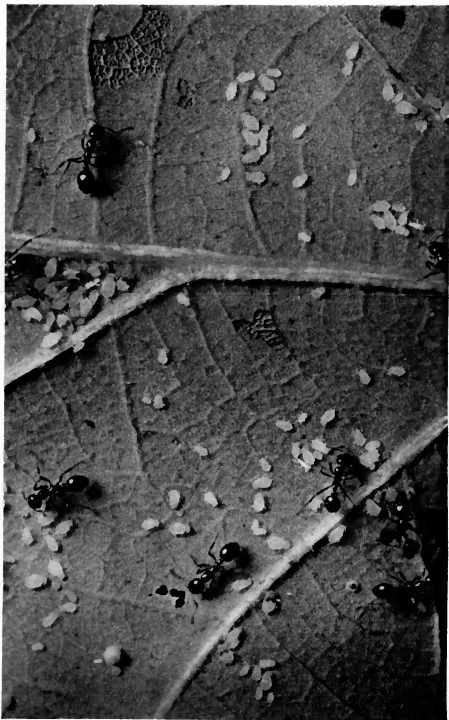
The future of the imported fire ant in the U. S. is difficult to predict. Energized by the highly adaptive genes of the light form, its rapidly growing populations may within the next 10 or 20 years come to cover all of the southeastern states. As a warm temperate-zone species that nests exclusively out-of-doors, it may never succeed in pushing north much beyond its present limits in Alabama and North Carolina, but within this range it will undoubtedly continue to wax as one of the most noxious of all insect pests.

The Department of Agriculture of course hopes to deal a lasting blow to the fire-ant population. But there are many potentially hindering complications in a program as broad as the one proposed. The possibility always exists that the natural enemies of the fire ant, including its various predators, parasites and competitors, will be hit harder by the Dieldrin insecticide than the ant itself. The subsequent relief of this form of environmental pressure on the ant may result in its rapid resurgence a few years after the spraying, perhaps to population densities even higher than those before the spraying was started. Another drawback lies in the generally poisonous nature of Dieldrin. Officials of several conservation organizations have recently joined in opposing the Government program on the ground that Dieldrin is extremely toxic to animals other than ants and in sufficient quantities is even dangerous to man. Indeed, field studies on the effects of Dieldrin have produced some alarming information. While evaluating the biological results of the sand-fly control program in Florida's St. Lucie County, R. W. Harrington, Jr., and W. L. Bidlingmayer of the Florida State Board of Health found that a pound of Dieldrin per acre of marshland destroyed the entire fish population of more than 30 species! Virtually all crustaceans also succumbed, and for a short period of time the only larger animals left alive in the treated water were mollusks. Thus a large and vital part of the aquatic fauna had been wiped out in one stroke.

It is probably too soon to judge whether similar detrimental side-effects will follow from the fire-ant control program, but it is at least clear that long-

range control of such vast insect populations is going to be a very complicated matter. It is likely that biological control—the introduction of new parasites and predators which attack the fire ant—will have to be attempted. This technique, which has been so effective in stopping other insect pests, has not yet been investigated with respect to the fire ant. Finally there is the ironic fact that the fire-ant infestation, if left alone long enough, would probably abate by

itself. A general characteristic of introduced populations is that in time native elements adjust to them and eventually reduce their density. But the period of adjustment could take years or decades, and continued research on control measures seems economically imperative. Meantime the imported fire ant will provide valuable clues as to the kind of genetic processes that underlie the adaptation of animal species to new environments.



WORKERS TEND APHIDS (small white objects) on the underside of a leaf. At certain times of year the fire ant feeds on the "honeydew" secreted by aphids and similar insects.